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Acanthocephalans of Amphibians and Reptiles (Anura and Squamata) from Ecuador, with the description of *Pandosentis napoensis* n. sp. (Neoechinorhynchidae) from *Hyla fasciata*

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Abstract

In a survey of 3457 amphibians and reptiles, collected in the Napo area of the Oriente region of Ecuador, 27 animals were found to be infected with acanthocephalans. Of 2359 Anura, 17 animals were infected with cystacanth stages of *Oligacanthorhynchus* spp., one frog with cystacanths of *Acanthocephalus* and one, *Hyla fasciata,* with a neoechinorhynchid, *Pandosentis napoensis* n. sp**.** Of 1098 Squamata, two colubrid snakes were infected with cystacanths of *Oligacanthoryrchus* sp., two with cystacanths of *Centrorhynchus* spp. and one with unidentifiable cystacanths; one lizard, a gekkonid, was infected with cystacanths of *Centrorhynchus* sp. and one lizard, an iguanid, with an *Oligacanthoryhnchus* sp. The new species, *P. napoensis* can be differentiated from its congenor *Pandosentis iracundus* in having a proboscis formula of 14 rows of 3 hooks as compared with 22 rows of 4 hooks and the lemnisci longer than the proboscis receptacle rather than the same length or shorter. *Pandosentis napoensis* may represent a host capture from fresh water fishes. Cystacanths of *Centrorhynchus* and *Oligacanthorhynchus* have been previously reported from South American amphibians and reptiles. Surprisingly, no adult *Acanthocephalus* were collected in this survey, although five species are known to occur in South American amphibians and reptiles.

Key words: Acanthocephala, *Pandosentis, Oligacanthorhynchus, Centrorhynchus, Acanthocephalus,* frogs, Anura, *Hyla fasciata,* Squamata Gekkonidae, Iguanidae, Colubridae, snakes, lizards, Ecuador, South America

Introduction

The acanthocephalan fauna of South America, particularly that of amphibians and reptiles, is not well known. A small number of reports including, from Argentina (Lajmanovich and Martinez de Ferrato 1995; Vizcaino 1993), Brazil (Travassos 1926; Hartwich 1956; Machado- Filho 1968, 1970; Vicente 1978; Stumpf 1981; Rodrigues 1986, 2001; Rodrigues et al. 1990; Catto and Amato 1994: Azevedo-Ramos et al. 1998; Vrcibradic et al. 2001, 2002; Bursey and Goldberg 2004), Chile (Fernandez and Ibarra 1989; Puga 1994; Torres and Puga 1996), Peru (Bursey et al. 2001), Uruguay (Hartwich 1956), and Venezuela (Van Cleave 1920; Lent and Portes- Santos 1989) have been published.

For Ecuador there is a single record of *Acanthocephalus sauria* Bursey and Goldberg, 2003 from the gymnophalmid lizard *Cereosaura oshaughnesseyi* (Boulenger, 1885), as *Prionodactylus oshaughnessyi,* by Bursey and Goldberg (2004). A search of the literature revealed no other reports from Ecuador, neither of cystacanths nor adults, from frogs and toads (Anura), or snakes and lizards (Squamata).

Ecuador is divided into three geographical regions, the Costa, between the Pacific Ocean and the Andes Mountains, the Sierra, the two major cordillera of the Andes Mountains and the Oriente, Andean foothills and eastern rainforest. This latter region is one of the world's richest rainforests. Water from the Andes collects in

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the Napo and Aguarico river basins; the Napo River is one of the Amazon River's principal tributaries.

The Muséum d'Histoire Naturelle, Geneva, Switzerland (MHNG) sponsored a series of surveys of the fauna of the vertebrates of the Napo River Basin between 1985 and 1988. As part of this program, helminths were collected from amphibians and reptiles. Ten species of anurans and seven species of squamatans were found to be infected with acanthocephalans.

In this paper the acanthocephalan assemblage for each host group is documented, new host and geographic locations are reported and a new species is described.

Material and methods

A total of 3457 animals comprising 2359 anurans, 804 lizards and 294 snakes were collected. Animals infected with acanthocephalans were found at the following localities: San Pablo de Kantesiya (0º15'S; 76º26'W); Shushufundi (0º13'S; 76º33'W); Tinalandia, near Santo Domingo de los Collarados (0º16'S; 78º52'W); and the road from Gualacia to Mendez (2º58'S; 78º42'W). All helminths were fixed in neutral 4% formalin and stored in 75% ethanol. Prior to microscopic examination, all specimens were cleared in lactophenol or Beechwood creosote to be studied as wet mounts. Subsequently, two adult male acanthocephalans were stained in Mayer's carmine, cleared in clove oil and mounted in Canada balsam for more detailed study. All measurements are given in micrometres. Illustrations were made with the aid of a drawing tube. Mean intensity of infection and prevalence was calculated for each host species. All the specimens collected for this study are held in the MHNG.

Results

The acanthocephalans collected are listed in Table 1. Seventeen of the 2359 amphibians were infected with cystacanth stages of at least 2 species of *Oligacanthorhynchus*. These species could be distinguished by having proboscis hooks with (type A) or without (type B) barbed tips. Further identification was not possible as details of the proboscis hook formulae could not be determined with any certainty. One host, identified only as an amphibian, was infected with cystacanths of *Acanthocephalus* sp. *Pandosentis napoensis* n. sp., described below, was found in an individual of *Hyla fasciata* Gunther, 1858*,* the only host infected with adult acanthocephalans.

Of the reptiles, two snakes were infected with cystacanths of a species of *Centrorhynchus* with a proboscis hook formula of 25–30 rows of 10 hooks plus 8–10 spines; two snakes were infected with a species of *Oligacanthorhynchus* having barbed proboscis hooks; and one snake was infected with a cystacanth that could not be identified further. A gekkonid was infected with a species of *Centrorhynchus* with a proboscis hook formula of 26 rows of 18 hooks and 13 spines and an iguanid was infected with a species of *Oligacanthorhynchus* having proboscis hooks without barbed tips (type B).

Prevalences of infection were low, ranging from 1 of 119 frogs (*Pandosentis napoensis* from *Hyla fasciata)* to 1 of 7 individuals (*Oligacanthorhynchus* sp. from the anuran *Nictimantis rugiceps* and the iguanid *Anolis punctatus)*.

All of these reports are new host and new locality records both for Ecuador and for South America.

TABLE 1. Acanthocephalans from Anura and Squamata from Ecuador, collected between April 1985 and June 1988. All parasite registration numbers have the prefix INVE.

** The prevalence for *Acanthocephalus* sp. from an amphibian was not calculated.

		Host	Helminth	Mean Intensity	Prevalence %	Reg. no. INVE
Anura						
	Bufonidae					
		Bufo marinus (Linnaeus, 1758)	*Oligocanthorhynchus* type A	1	3.9	38570
	Hylidae					
		Hyla boans (Linnaeus, 1758)	*Oligacanthorhynchus* type B	2	11.1	38571
		Hyla fasciata Gunther, 1858	*Oligacanthorhynchus* type B	1	2.5	38526, 38564, 38576
			Pandosentis napoensis	2	0.8	37763, 37766
		Hyla lanciformis (Cope 1871)	*Oligacanthorhynchus* type B	2.5	4	38578, 38582
		Hyla triangulum Gunther, 1869	*Oligacanthorhynchus* type B	1	2.3	38584
		Nictimantis rugiceps Boulanger, 1882	*Oligcanthorhynchus* type B	2	14.3	38573
		Osteocephalus taurinus Steindachner, 1862	*Oligacanthorhynchus* type B	1	2.2	38585
		Phyllomedusa tarsia (Cope, 1868)	*Oligacanthorhynchus* type A	25	5.3	38525
		Phyllomedusa spp.	*Oligacanthorhynchyus* type B	1	2.4	38580
	Leptodactylidae					
		Leptodactylus pentadactylus (Laurenti, 1768)	*Oligacanthorhynchus* type B	3	6.6	38583, 38568, 38575,
			Oligacanthorynchus type A			38574
	amphibian		*Acanthocephalus* sp	2	**	38527
Squamata						
	Colubridae					
		Dipsas catesbyi (Sentzen, 1796)	Cystacanth	1	2.2	38567
		Imantodes cenchoa (Linnaeus, 1758)	*Centrorhynchus* sp. A	2	1.2	38572
			Oligacanthorhynchus type B	4	1.2	38586
		Imantodes lentiferus (Cope, 1894)	*Centrorhynchus* sp. A	1	12.5	38556
		Leptodira annulata (Linneus, 1758)	*Oligacanthorhynchus* type *B*	2	10.0	38566
	Gekkonidae					
		Gonatodes concinnatus O'Shaunhessey, 1881	*Centrorhynchus* sp. B	1	2.1	38563
	Iguanidae					
		Anolis punctatus Dandin, 1802	*Oligacanthorhynchus* type B	1	14.3	38581

Family Neoechinorhynchidae Van Cleave, 1919

Genus *Pandosentis* Van Cleave, 1920

***Pandosentis napoensis* n. sp.**
(Figs. 1–7)

Type host: *Hyla fasciata* Gunther, 1858 (Hylidae).

Type locality: San Pablo de Kantesiya, Napo, Ecuador (0º15'S; 76º26'W).

Site of infection: Intestine.

Specimens deposited: Holotype, MHNG INVE 37763, paratype, MHNG INVE 37766, Muséum d'Histoire Naturelle, Geneva, Switzerland.

Etymology: The name *napoensis* refers to the Napo River Basin where the species was collected.

Description: Based on 2 male whole mounted specimens. Body small, tegument smooth, spineless. Proboscis small, sub-globular, with 12–14 longitudinal rows each of 3 hooks. Lacuna system with conspicuous canals connected by prominent circular anastomoses. In mid body, irregular diagonal lacunae connect with circular lacunae (Fig. 4). Giant hypodermal nuclei laterally distributed.

Males: Trunk fusiform 700–1000 long, 160 wide. Proboscis 78–85 long, 68–90 wide. Proboscis hooks all similar in length; hooks I 12–14 long, II 13–14 long, III 12–14 long; each hook within a papilla. Neck 30 long, 120 wide. Proboscis receptacle wall thin, single layered 100 long. Lemnisci 136, 170 long. Testes tandem, contiguous, in middle third of body; anterior testis 115–150 long, 46–70 wide; posterior testis 125–160 long, 60–90 wide. Single cement gland globular to pyriform, 80–100 long, 40–70 wide; cement reservoir, posterior to cement gland; Safftigen's pouch long, posterior to cement reservoir, adjacent to seminal vesicle.

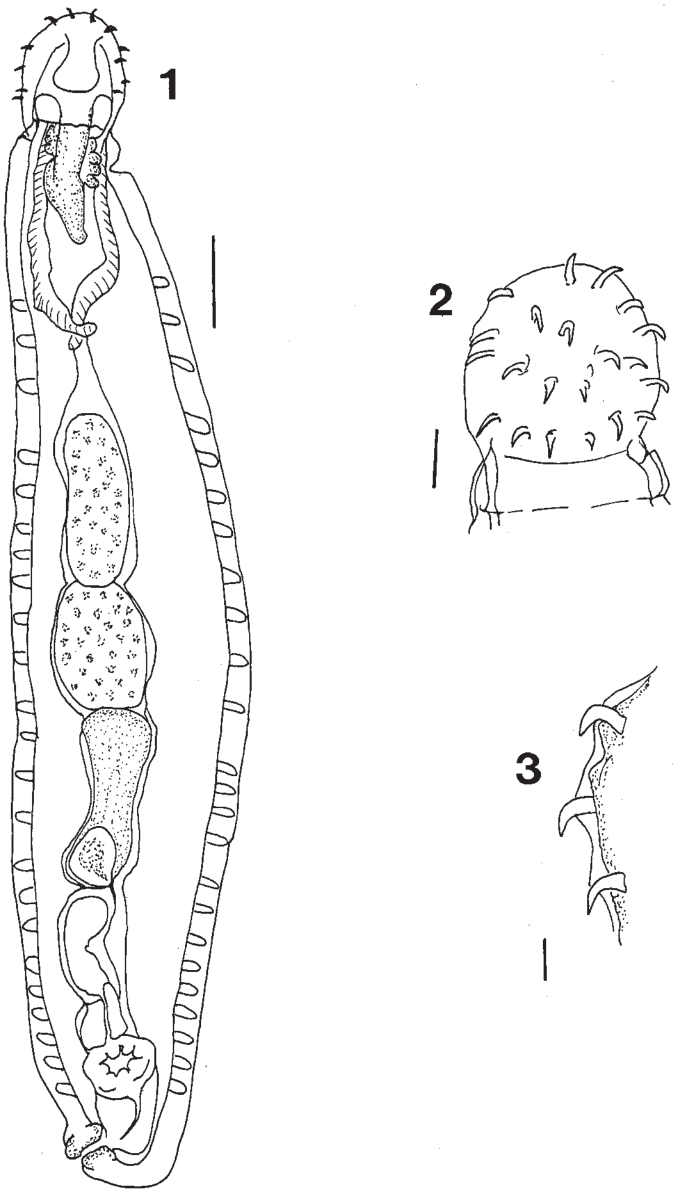
Remarks: The two males available for study possess the morphological characteristics of the family Neoechinorhynchidae, sub-family Gracilisentinae as defined by Amin (1982). The Gracilisentinae comprises three genera. *Pandosentis* Van Cleave, 1920, a monotypic genus, occurs in freshwater fishes from Venezuela (Van Cleave 1920). *Gracilisentis* Van Cleave, 1919 comprises three species, one of which, *G. variabilis* (Diesing, 1856), occurs in freshwater fishes from Brazil. *Wolffhugelia* Mané-Garzon & Dei-Cas, 1974, a monotypic genus, occurs in freshwater fishes in Uruaguay. The three genera resemble each other closely in general body form and morphology. They differ from each other in the form of the lacunar system, the distribution of the hypodermic nuclei, the form of the proboscis receptacle, the presence or absence of papillae in which hooks are embedded, the form of the proboscis, and the proboscis hook formula (Van Cleave 1920; Thatcher 1991). On this basis, the new species with a lacuna system of conspicuous canals, prominent circular anastomoses and irregular diagonal lacunae at the mid-body; giant hypodermal nuclei laterally distributed; proboscis receptacle with delicate thin, single layered wall, well developed invertor muscles and proboscis hooks embedded in papillae falls within *Pandosentis*. Unfortunately the detailed morphology of the roots of the proboscis hooks of the specimens of *P. napoensis* was difficult to distinguish, but they appeared to conform to the description of Van Cleave (1920) in having no distinct line of separation between thorn and root.

Although only two males of *Pandosentis napoensis* n. sp. were found they were fully mature and could be clearly differentiated from *Pandosentis iracundus* Van Cleave, 1920 in having 14 longitudinal rows of 3 hooks rather than 22 longitudinal rows of 4 hooks, the lemnisci longer than the proboscis receptacle and the cement gland about the same size as the testes rather than smaller. The characters proboscis hook formula and the relative lengths of the lemnisci and proboscis receptacle are not congruent with the present generic diagnosis of *Pandosentis* (see Thatcher 1991). The latter character is problematic for the group in that nearly all the specimens studied by Van Cleave (1920) had inverted proboscides, no measurements for the length of the lemnisci were given and the lemnisci appear to be figured as at least as long as the proboscis receptacle (Van Cleave 1920 Plate 27, Figs 5, 6). The establishment of a new genus on the basis of proboscis hook numbers

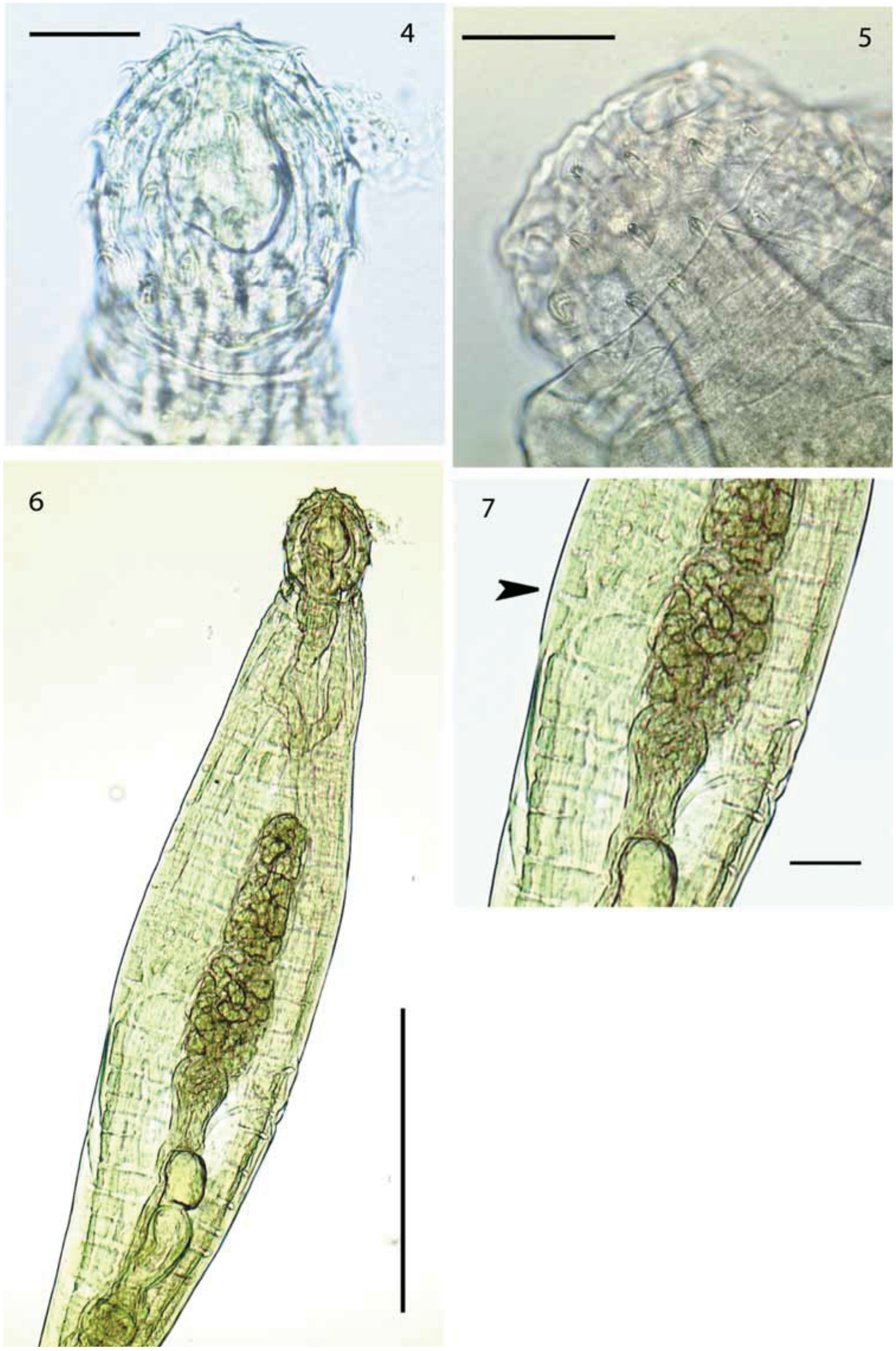
alone, however, does not seem warranted at this time.

Pandosentis iracundus has been reported from two freshwater fish hosts, *Aquidens pulcher* (Gill) and *Crenicichla geayi* (Pellegrin) from Lake Valencia, Venezuela (Van Cleave 1920), as well as from *Aquidens* sp. and *Mesonauta insignis* from Pucallpa and Quistococha, Peru (Tantaleán et al. 2005). Peru does not share a border with Venezuela, however, but with Equador, where *P. napoensis* occurs, albeit in an amphibian. It is possible that the Peruvian material is also *P. napoensis* rather than *P. iracundus,* but unfortunately the identity of the original material could not be confirmed. The marked difference in proboscis hook formulae, however, makes this unlikely.

Although primarily parasites of fishes, the Neoechinorhynchidae also are found in frogs (Amin 2002) and turtles (Barger and Nickol 2004). Moreover, Bush et al. (1990) noted the capture of neoechinorhynchid acanthocephalans by amphibians or reptiles, as one example of the importance of the process of host capture in contributing to the species richness of helminth communities. Finding *P. napoensis,* a neoechinorhynchid, in a frog from Ecuador that has congenors in fishes from Venezuela and Peru may be another example of this process.



FIGURES 1–3. *Pandosentis napoensis* **n. sp. 1.** Adult male, ventral view. **2**. Proboscis armature, lateral view. **3.** Longitudinal row of hooks, lateral view. Scale bars: **1** = 60µm; **2** = 25µm; **3** = 10µm.



FIGURES 4–7. Micrographs of *Pandosentis napoensis* **n. sp. 4.** Proboscis, specimen 1. **5.** Proboscis, specimen 2. **6.** Specimen 1 ventral view. **&.** Lacuna system showing irregular diagonal lacunae connecting with circular canals. Scale bars: **4** = 20µm; **5 & 7** = 40µm; **6** = 200µm.

Discussion

The low prevalences (0.8–14.3%), of acanthocephalans found in both Anura and Squamata, in this survey, are consistent with the findings of similar surveys of amphibians and reptiles from South America (Bursey et al. 2001).

In the present study the anuran fauna was dominated by oligacanthorhynchid cystacanths (17 of 19 hosts). At least 7 species of *Oligacanthorhynchus* have been described from Brazilian hosts and the type species, *O. spira* (Diesing, 1851), is found in neo-tropical regions (Golvan 1994). There was, however, insufficient morphological data available from the material to assign the cystacanths to species. Only one anuran was infected with cystacanths of *Acanthocephalus*. This was unexpected because adults of *Acanthocephalus* occur in a wide range of amphibians and at least five species have been described from Argentina, Brazil and Venezuela. The adults of *P. napoensis,* found in a single host, could represent a host capture from freshwater fishes, as discussed above (Bush et al. 1990). Alternatively, this finding could represent an occasional infection in an amphibian of a species, usually occurring in an as yet unknown fish host, as has been reported for other acanthocephalans found in fresh water hosts (Flynt and Lisitsyna 1995; McAlpine 1996). Additional study of potential fish hosts, and more collections of *P. napoensis* from *Hyla fasciata* are needed before the required hosts can be determined. The generic diagnosis for *Pandosentis* as revised by Thatcher (1991) is, for the most part, consistent with the description of *P. napoensis*. Some adjustment to the diagnosis, however, is needed to encompass the new species. Accordingly an emended diagnosis is given below.

The Squamata examined herein were infected not only with cystacanths of *Oligocanthorhynchus* but also of *Centrorhynchus.* Species of *Centrorhynchus* have been described from birds from the neotropical region, including Chile, Brazil, Colombia, Paraguay and Venezuela. Again, although cystacanths could be differentiated by proboscis hook formulae, they could not be assigned with any certainty to a known species.

Given the rich diversity of bird life in the Oriente Region of Ecuador it is not surprising that cystacanths were found in putative paratenic hosts. What was surprising was that, despite the large number of animals examined, only one was infected with an adult acanthocephalan, and none were infected with adult acanthocephalans that are found elsewhere in the same families of Anura or Squamata. No adults of *Acanthocephalus,* for example, were found in this survey. Nor were found any individuals of *Sphaeroechinorhynchus*, common parasites of snakes. There are no simple explanations to account for these findings.

Revised diagnosis *Pandosentis*

Body small; hypodermic giant nuclei median or lateral. Proboscis short, cylindrical, with 14– 22 longitudinal rows of 3–4 hooks per row; boundary between root and thorn not sharply marked. Proboscis receptacle with thin single wall. Lemnisci longer or shorter than proboscis receptacle. Testes contiguous, in middle body third. Cement gland syncytial, with16 nuclei. Parasites of freshwater fishes and amphibians.

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